

when it counts, but it also makes one wonder how the 150 drop lengths assumed by the model are adequate to serve lots with over 1,000 feet of frontage.⁷³

A second example is a cluster in the TSVL wirecenter with 1,836 lines and an area of 0.67 square miles.⁷⁴ Not only does this cluster violate the upper limit of 1,800 lines that was supposed to constrain cluster formation, but its density of 2,743 lines/square mile ($1,836/0.67$) greatly exceeds the 981 lines per square mile used to perform cost calculations.⁷⁵

C. HM 5.0 Substantially Changes Distribution Plant Design.

In addition to changing the data source and representation of hypothetical local serving (distribution) areas, HM 5.0 has changed the engineering design so as to produce substantial differences in structures, cable, and the resulting costs for distribution plant.

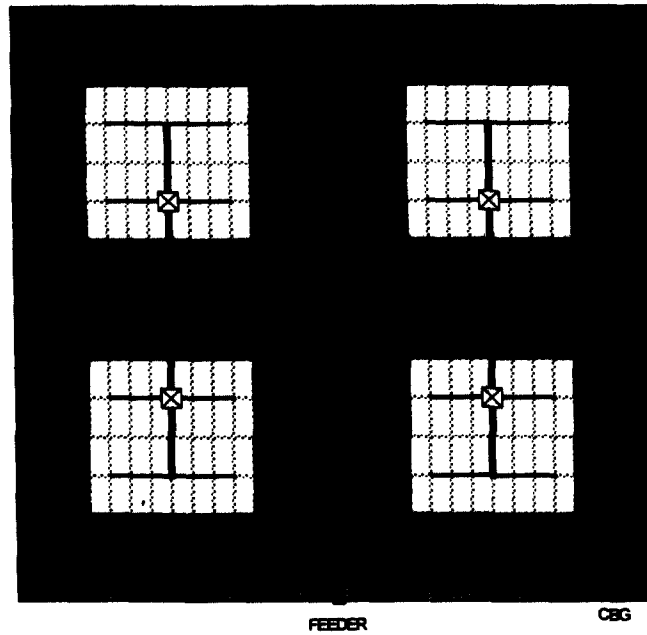
To illustrate this point, consider the hypothetical distribution area of HM 3.0, 3.1 and 4.0 ("window-pane" approach), which has been electronically reproduced from a previous version of the Hatfield Model documentation.

⁷³ Clusters with large lot sizes are not rare. Over 75 percent of GTE-Alabama clusters (848 out of 1,128) have lot sizes of at least 40 acres. In fact, the average lot size over all locations is 36 acres. Note that the use of the outlier subclusters does not appreciably improve that imprecision arising from these large average lot sizes. Fewer than 300 lines (one tenth of one percent) are in outlier sub-clusters.

⁷⁴ Fourteen clusters in GTE-Alabama territory exceed the 1,800 line constraint that was evidently supposed to apply in forming distribution areas.

⁷⁵ Certain cost inputs vary with density. For example, the correct density category (2,550-5,000) has higher costs for buried drop placement, uses more underground structure, and closer pole spacing than does the density category (850-2,550) used to determine costs for this cluster.

Figure 2⁷⁶
HM 3.0, 3.1 and 4.0 Distribution Architecture



As illustrated above, connecting cable runs from the center of the distribution area (which coincides with the location of the SAI, in case of copper connecting cable) into each of the four

⁷⁶ Hatfield Model, Release 3.1, Hatfield Associates, Inc., Boulder, Colorado, February 28, 1997, page 29.

quadrants. From there, backbone cables run in the north-south direction down the middle of each quadrant. Finally, branch cables run in the east-west direction from each of the branch cables.

Applying the "window-pane" methodology to a distribution area of 128 locations results in the following cable statistics.⁷⁷

Table 2
Cable Investment HM 3.0, 3.1 and 4.0

Type	Number	Pairs	Length
Connecting	4	100	1,400
Backbone	4	100	933
Branch	16	25	700
Route feet		18668	
Cable Cost ⁷⁸		\$33,276	
Structure Cost		\$35,954	
Total Cost		\$69,230	

In HM 5.0, the SAI is also in the center of the distribution area. Two backbone cables run north-south from there in opposite directions. From each of the backbone cables run branch cables in the east-west direction.

Assuming a cluster of equal size and density as the squared representation of the CBG above, the "new" distribution design results into cable statistics:

⁷⁷ For purposes of this exercise, assume that there are no empty areas (so that the "windowpanes" are contiguous) and that the square serving area is 0.5 miles on a side.

⁷⁸ Default inputs are used with the exception that 100 percent buried placement is assumed. Earlier releases place the following cable types.

Table 3
Cable Investment HM 5.0

Type	Number	Pairs	Length
Connecting	NA	NA	NA
Backbone	2	200	1,400
Branch	8	50	1,633
Route feet		15867	
Cable Cost ⁷⁹		\$28,340	
Structure Cost		\$30,651	
Total Cost		\$58,991	

In effect, HM 5.0 has replaced the four connecting/backbone cables with two larger (more pairs) cables and has connected the branch cables in adjacent quadrants. As a result, there are fewer route feet and larger cables (which tends to lower the per pair cost of cable). As a result, HM 5.0 lowers total cost by about 15 percent in this example.

What is significant about this example is that in its various incarnations, the Model's supporters have claimed that they are employing classic engineering design, informed by the many years of experience of the engineering team. Yet, between successive versions of the Model, the engineering of comparable situations can change in ways that substantially changes costs, often in a downward direction.⁸⁰

⁷⁹ Default inputs are used with the exception that 100 percent buried placement is assumed. Earlier releases place the following cable types.

⁸⁰ Earlier examples include the reduction in the cost of structure between Releases 2.2.2 and 3.1, which reduced the per foot cost by a factor of 2-3 and offset a comparable increase in route feet between the models and the reduction in the cost of larger copper cables between Releases 3.1 and 4.0

III. THE HATFIELD MODEL VIOLATES STANDARD ECONOMIC PRINCIPLES

The purpose of considering cost models in this proceeding is to provide accurate TELRIC estimates of unbundled network elements and TSLRIC estimates for universal service purposes. In theory, these estimates should be less expensive and less time consuming than performing a separate cost study every time a network element needs to be unbundled in a new geographic area. From an economic perspective, however, the key criterion in judging and evaluating these models must be accuracy. While ease of use, openness, and independence from proprietary data are certainly desirable features of a cost model, accuracy is of much higher importance. If a model produces inaccurate estimates, it is entirely useless, regardless of its features, and will foil the very competition that this Commission hopes to foster. Therefore, in our review of the Hatfield Model, we focus particularly on the accuracy of the Model's results.

This section demonstrates that the HM 5.0 *is not* a valid cost model. The economic flaws of HM 5.0 are largely identical to the criticism of the Model's predecessors. This is due to the fact that close to none of the economic flaws in the Model have been addressed since our first look at the Hatfield Model in Release 2.1. We discuss modeling errors as they pertain to economic theory and show that HM 5.0 builds its cost estimates on a myriad of modeling errors and incorrect input values.

A. The Model Fails External Validity Tests

External validity checks are tests that verify whether the Model's cost estimates can be confirmed by comparison to external measures of the same costs. Without external validation, a model is simply a speculative construct, and should not serve as a basis for determining the costs of a real functioning firm. Our analysis has revealed that the Hatfield Model is *not* a valid economic

cost model because it has not undergone sufficient external validity tests and fails those to which it has been subjected.

To illustrate and substantiate this point, consider a cost model that predicts a particular cost per line. An external validity check for this model would consist of comparing a random sample of the model's estimates to *actual* costs. If the estimates deviate substantially from the actual data most of the time, the model is not considered a useful or accurate tool to predict these costs.

The Hatfield proponents respond to this criticism by claiming that to use historical or even current data is to use embedded costs and that using embedded costs and therefore historical cost data is precluded by the desire to estimate presumably lower forward-looking costs.⁸¹ Moreover, such an assertion demonstrates a lack of understanding about cost modeling and the relationship between forward-looking and embedded costs.

First, for many types of costs, actual cost levels can serve as an excellent *starting* point for forecasts of forward-looking costs.⁸² For many components of the local loop, current costs are often significantly higher than historical or embedded costs.⁸³ Indeed, the Hatfield Model proponents have consistently argued that its loop costs are based on technology that has been in place for years and that current engineering practices are followed. In these circumstances, observations of actual costs can be considerably more reliable than cost estimates based on a hypothetical blueprint that has

⁸¹ Rebuttal to "Economic and Algorithmic Errors in the 'Update' Hatfield Model Release 4.0" by Stephen E. Siwek, GTE /AT&T Arbitration Proceeding, New Mexico Public Utilities Commission, Docket No. 97-35TC, June 13, 1997, at 2.

⁸² Economists routinely employ such models to study the cost characteristics of a firm or industry. For example, Professor David Kasserman, testifying on behalf of AT&T, cited an econometric study of telephone company historical costs in support of his assertion that local exchange service is not a natural monopoly. (See Richard Shin and John S. Ying, "Unnatural Monopolies in Local Telephone," *Rand Journal of Economics*, Vol. 23, 1992, pp. 171-183.)

⁸³ Turner Index (attached hereto as Attachment 13).

never formed the basis for a functioning network.⁸⁴ Indeed, in a forward-looking basis, the costs produced by a model designing and placing an entirely new network, and taking into account (though HM 5.0 does not do so) new obstructions such as roads, sidewalks, and buildings, may in fact be higher than a ILEC's actual costs.

Second, validation of the Model could easily be done by using the Hatfield Model to predict the costs for any combination of cost drivers that *can* be observed, and compare its predictions to the actual observed costs associated with this combination. If the Model predicts this well, and if the new combination of drivers is not too far out of the range of the observed combinations of drivers, then an evaluator has reasonable confidence that the Model will predict the new cost for the new combination.

As a partial test of the Model's validity, we offer the following analysis. We compare the dollar investments and expenses predicted by the Hatfield Model to those reported in ARMIS reports 43-03, 43-04, 43-07 and 43-08 (ARMIS) by GTE. Despite the fact that not a single dollar of GTE's investments and expenses have been found imprudent or insufficient by the Alabama Public Service Commission, the Model's cost estimates suggest that in a forward-looking environment, GTE should incur only 50% of its current plant non-specific operations and only 55% of its current total operating expenses. A model that produces forward-looking costs that are one-half of the level of actual costs defies common sense and basic economics.

⁸⁴ This is because the actual costs incorporate all the impacts of engineering experiences, uncertain and/or erratic growth while still maintaining appropriate grades of service for installation intervals, post dial tone delay, functioning lines in 911 emergencies, floods, hurricanes, and others. Costs based on models that do not account for these facts of life will yield networks that do not satisfy the grades of service and reliability that customers demand.

This significant reduction is all the more startling when one considers that many forward-looking costs will exceed embedded costs. While many cost inputs in the telecommunications industry have been decreasing, most of these cost declines for local exchange companies have been associated with switching and transport features. The lion's share of an ILEC's costs, however, are associated with the loop -- and forward-looking loop costs will be greater than embedded loop costs. For example, forward-looking structure costs can be expected to exceed embedded costs due to the increased urbanization that has occurred since the distribution network was initially built. More forward-looking placement will be necessary in paved and urbanized areas -- and associated costs will escalate accordingly. In addition, forward-looking structure mix should be weighted more heavily toward underground and buried placement due to municipal zoning restrictions. Over the years, it has become much more common to install underground and buried structure rather than the less expensive aerial structure.

Rights-of-way costs have also risen since the embedded plant was designed. A number of municipalities have begun to impose high fees -- sometimes up to five percent of gross revenues -- to build and maintain telecommunications facilities. It is likely that many rights-of-way fees have been fully amortized in the embedded rate base. Finally, labor and material costs necessary to build the loop have increased -- and will continue to increase. The Turner Price Index shows that the cost of copper wire has increased consistently over time. So too have labor costs. Depending upon the particular vintage an ILECs' distribution plant, we expect forward-looking loop costs to be significantly higher than the ILEC's historic cost of construction. The fact that the Hatfield Model produces costs that are *one half* of the magnitude of an ILEC's actual costs should serve as a strong warning to this Commission.

The following table displays the amounts of disparity between actual and Hatfield Model-predicted costs and casts extreme doubt on the Model's predictive ability.

Table 4
Investment and Expense Comparison
GTE Alabama
(GTE Territory)

<u>Cost Category</u>	<u>Actual</u>	<u>Model</u>	<u>Model/Actual</u>
(1)	(2)	(3)	(4)
			(3)/(2)
Total Plant In Service	\$346,132	\$280,575	81%
Plant Specific Expenses	\$21,400	\$13,713	64%
Plant Non-Specific Expenses	\$38,682	\$19,255	50%
Corporate Operations	\$11,011	\$6,444	59%
Total Operating Expenses	\$71,093	\$39,412	55%

In fact, AT&T's own filing with the FCC (attached hereto as Attachment 14) confirms that the Hatfield Model provisions investments and associated expenses that are in disparity with those of an ILEC's existing network. An excerpt from AT&T's filing appears below.

Table 5
AT&T Ex Parte Filing

USOA Number	USOA Description	Hatfield to ARMIS Ratio for SW Bell
2110	Total Land & Support Assets	31%
2220	Central Office Switching	24%
2230	Transmission	47%
2310	Total Information Orig/Term	26%
2410	Total Cable & Wire Facilities	60%

Another example of HM 5.0's failure to accurately replicate external realities is seen when one compares actual customer locations and wire center assignments with what HM 5.0 assumes. The Hatfield Model purports to start with the current locations of the ILEC's wire centers. It then constructs loop plant (feeder, distribution and associated structures) from the wire center locations to the customer premises by assigning the CBGs to the wire center that serves the greatest number of phone numbers.

This approach fails to properly size each wire center in the network it models. The Model derives types and quantities of lines from Census Bureau data. It applies to these data broad and imprecise assumptions about second lines and business lines per location to these data. The Model does not even assign the correct quantities of residence and business lines to the corresponding wire centers. The majority of wire centers modeled by HM 5.0 contain line counts that differ by more than 10% from actual wire center line counts in GTE's network.

As a means of further testing the external and internal validity of the Hatfield Model, an analysis was performed to determine the switching investment per line actually produced by HM

5.0 when it is run for all GTE/Contel states in the country. The output of this analysis was then compared to the GTE per line switch investment figure assumed in the Model.⁸⁵ In theory, HM 5.0's GTE switch investment assumption should equal the actual investment figure produced by the Model. The fact that this does not occur highlights yet another inconsistency within the Model.

Each version of the Hatfield Model uses data from a Northern Business Information (NBI) publication as the primary source for switch costs.⁸⁶ HM 5.0 uses this NBI data to calculate per line switch cost based on an average switch size. The NBI figure for GTE's per line price (as described in the Model) is \$118. HM 5.0 adjusts this per line switch cost to account for the engineering, furnishing, and installation (EF&I) of the switch equipment by applying an installation factor of 10%. Applying this installation factor to the NBI per line switch cost results in a per line switch cost of \$129.80 (\$118 +10%). This \$129.80 value should represent GTE's installed switch costs on a per line basis as calculated by the Hatfield Model.

HM 5.0 was run in default mode for all GTE and Contel locations.⁸⁷ The Model's investment input spreadsheet for each jurisdiction was used to produce a summed total of all GTE/Contel switched lines (13,600,344) and corresponding switching investment (\$1,442,578,701). Dividing the

⁸⁵HIPS 5.0, Section 4.1.9.

⁸⁶The NBI Study purportedly summarizes all switch purchases made by all major telephone companies, year over year, and displays the resulting average prices on a per line basis. In 1996, the alleged average cost per line for switching incurred by GTE as reported by NBI was \$118. GTE has been unable to obtain the underlying data in the NBI study and does not consent that the figure reflected in the NBI study is correct. For a further discussion of the shortcomings in the Hatfield Model Switching Module, See Section V, Part B of this paper.

⁸⁷When run in default mode, HM5.0 uses the NBI-based switch cost curve to estimate ILEC per line switch investment.

Model's total lines into the Model's total investment produced a per line GTE switching investment value of \$106.07.

The variation between the computed per line switching cost produced by the Model (\$106.07) and the purported publicly available per line switch cost data used in the Model (NBI adjusted for EF&I -- \$129.80) represents an inconsistency in HM 5.0 and demonstrates the inability of the Model to produce credible results. HM 5.0 relies upon the NBI study as a means for representing ILECs' forward looking costs, yet the Model's internal computations are incapable of duplicating the relied upon data. When compared to the NBI data, the Hatfield Model produces a deficit of \$23.73 for every GTE line in service, or over \$322 million in investment shortfall. Such a result is an attestation to the Model's deficiencies.

B. The Model Assumes Non-Realistic Market Conditions

The primary purpose of a cost model is to answer the question of what the minimum cost of producing a stream of outputs is using the most efficient forward-looking technology and facing an uncertain stream of input prices. To use a cost model to calculate the TELRIC/TSLRIC for a particular product or service, one calculates the minimum cost of doing business as usual and subtracts from that the minimum cost of doing business if that particular product line or service were dropped from production. Both components of this difference must be *dynamic* cost functions. By this we mean that costs are calculated over a planning horizon. Single-period, static cost functions are inappropriate for estimating TELRICs.

From a modeling perspective, the Hatfield Model is a static model in that it sizes facilities to accommodate demand levels in a single year, rather than accounting for the vicissitudes of demand changes in a dynamic industry. Consequently, it ignores inflation rates and the high likelihood that

competition will (1) further increase the real cost of capital because of the associated increased risk, and (2) increase economic depreciation rates required to recover investment in plant and equipment due to increased technological change.

There is little question that the Model assumes a default value for the cost of capital (10.01%) that is significantly understated. First, the FCC's approved rate of return remains at 11.25 percent.⁸⁸ Second, the whole premise behind the Model's cost estimates is to emulate the effects of competition. One of the effects of competition is increased risk. This, in turn, increases the annual capital cost for local exchange services and unbundled network elements.

Similarly, the forces of competition itself, as well as the rapid technological change that permeates the industry, invalidate the use of the historical and regulated depreciation lives. Schmalensee and Rohlfs, for instance, reported that AT&T's depreciation rate is 18.5 percent.⁸⁹ Even AT&T's 1994 book depreciation rate of about 11 percent is higher than the rates used in the Hatfield Model. Indeed, in his reply affidavit filed with the FCC in CC Docket 96-98, Professor Hausman demonstrates that accounting for the increased risk and uncertainty of competition increases the annual cost related to investments by a multiple of at least three.⁹⁰

The static nature of the Model also results in underestimation of the true economic cost of network investment. By inadequately accounting for growth in demand, the Model mischaracterizes the spare capacity that results from the optimal timing of laying discrete plant, instead labeling it as

⁸⁸ 5 FCC Rcd. No 25 CC Docket 89-624.

⁸⁹ Richard Schmalensee and Jeffrey H. Rohlfs, "Productivity Gains Resulting From Interstate Price Caps for AT&T," National Economic Research Associates, September 1992.

⁹⁰ "Reply Affidavit", J. Hausman, CC Docket 96-98, May 30, 1996.

inefficient excess capacity. As a result, Hatfield proponents typically insist on fill factors that are too high and cost estimates that are too low.

The Hatfield documentation characterizes the Model as "scorched node," meaning that it commences with the existing wire center locations and subsequently builds a brand new network instantaneously from the ground up. This structural and operating assumption ignores the ILEC's actual costs and existing physical plant. The Model begins with the assumption that the ILEC's present facilities and assets will be abandoned. In its place an entirely new telephone system will be constructed that will take advantage of the most streamlined distribution routes in disregard of real work obstacles, the most advanced technology, and, of course, the lowest possible costs. The Hatfield Model designs a network unrelated to the State of Alabama that cannot and will not be built in the manner prescribed.

From an economic and engineering view, Hatfield's scorched node assumption is unrealistic. An actual firm does not incur costs this way. It builds in a modular and incremental fashion. It takes advantage, of course, of the latest technological developments, but these changes take place over time. Even the Hatfield proponents acknowledge that the assumed reconstruction of the ILEC's network would not occur in a real-world situation and that certain of Hatfield's assumed efficiency gains would take a number of years to manifest.⁹¹

The purpose of this proceeding, however, is to adopt a model capable of predicting *current* costs for forward-looking technology -- not tomorrow's costs. Unrealistic and currently unachievable

⁹¹ Testimony of AT&T witness Dr. Nina Cornell before the Washington Utilities and Transportation Commission, Docket No. UT-960369,-70,-71, July 10, 1997, Tr. at 753-55.

network assumptions cannot, by definition, serve as the basis for estimating *today's* cost of operating a forward-looking network.

IV. THE HATFIELD MODEL DOES NOT COMPLY WITH THE FEDERAL-STATE JOINT BOARD'S LIST OF CRITERIA AND HAS BEEN REJECTED BY SEVERAL STATE AGENCIES

A thorough review of the Hatfield Model, its inputs, assumptions, and methodology clearly demonstrates that the Model is incapable of being used to estimate the costs of providing universal service. The FCC has stated that the Hatfield Model in its current state is not reliable. The State Members of the Federal-State Joint Board on Universal Service ("State Members") have rejected the Model. The Federal-State Joint Board on Universal Service ("Joint Board") analyzed and rejected many of the Hatfield Model's assumptions. Specifically, the Joint Board tentatively concluded that the Hatfield Model needed to calculate population clusters' proximity to wire centers with *more precision*, accurately predict line counts, incorporate terrain factors into their plant mix tables, allocate 100% of the cost of plowed cable to ILECs, use forward-looking technology in longer loops, and base switching costs upon "actual ILEC switching purchases," not the unrealistic Hatfield switching curve.⁹² Rather than correct these deficiencies, Version 5.0 has virtually ignored them. In fact, the Hatfield modelers have exacerbated these problems by the introduction of shared buried drops and the utilization of obsolescent 1970s technology in long loops.

On May 8, 1997, the Federal-State Joint Board on Universal Service in CC-Docket No. 96-45 released its Report and Order on Universal Service. In paragraph 250, the Joint Board laid out ten (10) criteria for forward-looking economic cost determination.

⁹² Further Notice of Proposed Rulemaking, Before the Federal Communications Commission, CC Docket Nos. 96-45 and 97-160, July 18, 1997, Paragraphs 44,53,58,67,80,86.

We have evaluated the Hatfield Model, Release 5.0 on these criteria and despite claims made by the Model's sponsors, our evaluation has revealed that the Hatfield Model fails the vast majority of these requirements. Appendix C of this paper describes in detail the Hatfield Model's compliance or non-compliance with each of these requirements.

Other state utility commissions also have rejected the Hatfield Model. The Massachusetts Department of Public Utilities rejected the Hatfield Model in an arbitration proceeding finding that its network design was "unrealistic," and that the Model has "the clear potential . . . to present skewed results with regard to local loop plant investment" and that its configuration of outside plant is "unverified and without support."⁹³ The Texas Public Utility Commission rejected the Hatfield Model because, in part, it "neglect[ed] many of the costs associated with actually designing, engineering and installing a network."⁹⁴ The Model was rejected in New York because it relied "heavily on simplifying assumptions that by their nature can never be substantiated and by failing to pay adequate attention to the outside world as it really exists."⁹⁵ State commissions in Florida, California, Missouri, New Mexico, Hawaii, Kentucky, Pennsylvania, and Maryland have similarly rejected the bargain basement rates proposed by Hatfield.⁹⁶ Few have embraced or approved the underlying theory, design, or assumptions of the Hatfield Model.

⁹³ Commonwealth of Massachusetts, Department of Public Utilities Arbitration Order in NYNEX, AT&T, MCI Consolidated Proceedings, Dec. 4, 1996 at 21.

⁹⁴ Texas Public Utility Commission, Docket No. 16189, Dec. 18, 1997 at 32. In New York.

⁹⁵ State of New York Public Service Comm., Case No. 95-C-0657, April 1, 1997 at 116.

⁹⁶ Florida Public Service Comm., Order No. PSC-97-0064-FOF-TP, Jan. 17, 1997 at 31; Draft Decision of ALJ McKenzie, Before the Public Utilities Commission of the State of California, R.93-04-003 and I. 93-04-002 Mailed December 23, 1997; Missouri Public Service Comm., Case No. TO-97-40/RO-97-67, Dec. 11, 1996 at 6; Findings of Fact, Conclusions of Law and Order, Before the New Mexico State Corporation Commission, Dkt. No. 97-35-TC, Sept. 19, 1997; Kentucky Public Service Comm., Case No. 96-440, Feb. 14, 1997 at 22; Pennsylvania Public Utilities Comm., Dkt. No. A-310203F0002, April 10, 1997 at 20; Maryland Public Service Comm., Case No. 8731, Phase II, Order No. 73707, Sept. 22, 1997 at 12.

V. THE HATFIELD MODEL VIOLATES STANDARD ENGINEERING PRACTICES AND UNDERSTATES ASSOCIATED COSTS

The Hatfield Model's engineering assumptions are so flawed that they result in a network that is inoperable, which causes the associated cost assumptions to be equally unrealistic.

A. The Model Produces A Flawed Model of the Loop Network

The loops designed by the Hatfield Model are too short to provide service to all customers, and are based upon outdated technology for certain components.

1. Inadequate Cable Length

Distribution and feeder cable are essential components of the loop. They connect users both with other users and the equipment necessary to operate a telecommunications network. HM 5.0 does not accurately estimate the amount of cable necessary to connect users to the network. Hatfield makes such inaccurate estimations for several reasons. The Hatfield Model uses an overly simplistic approach to determine feeder plant distance by applying "straightforward trigonometric calculations" to cluster location parameters. HM 5.0 uses the calculated feeder plant distance to generate the necessary feeder plant investment that will be accounted for by the Model. HM 5.0 uses similar mathematical functions to determine the amount of distribution cable distances within each cluster.

The flaw in Hatfield's calculation of distribution cable length is evident in the validation study performed by Hatfield sponsors at the request of the Georgia Public Service Commission Staff. In this study, the Hatfield supporters attempted to validate that the distribution footage modeled by HM 4.0 for ten CBGs in the state of Georgia. AT&T and MCI's estimated that HM4.0 produces 92.5 percent of the route footage required for the 10 Georgia CBGs.

We have reviewed this study and found it to be incorrect. The correct percentage is 70.3; *in other words, HM4.0 underestimates necessary route feet by 30 percent.*⁵⁴ Recent studies indicate that the cable lengths produced by HM 5.0 may not be significantly different. These study results suggest that Hatfield provides insufficient cable footage and confirm that the network produced by the Model does not adhere to basic engineering practices.

HM 5.0's method of estimating feeder and distribution distances understates total loop lengths as well as the corresponding investment and expense associated with the local loop. The last nationwide study of actual loops indicates that the average BOC total loop length is 12,113 feet, and that the average airline distance between the customer location and the serving wire center is 7,692 feet.⁵⁵ Dividing the loop length by the airline distance produces a "route-to-air" ratio that can be used as an indicator of routing efficiency. The route-to-air ratio for the average BOC loop is 1.58. In contrast, the average route-to-air ratio that can be attained using the default HM 5.0 loop distance methodology is 1.44 (1.38 for feeder routes that are "steered" using HM's default route to air) -- 9% less than the average BOC route-to-air ratio. This means that the HM 5.0 loop lengths are significantly shorter -- artificially shorter -- than the actual loop lengths in the ILEC's network. Based on these calculations, we conclude that the loops produced in HM 5.0 are not long enough to serve the majority of GTE customers.

2. Obsolescent Technology

⁵⁴ Their error is the result of miscalculating the routes associated with connecting cable. For CBGs for which the connecting cable is fiber, and therefore part of the feeder, AT&T and MCI has incorrectly included these connecting cable routes as part of distribution plant in its response to the Georgia Commission. For CBGs for which the connecting cables are copper, and therefore properly included as distribution plant, the AT&T and MCI calculation "double counts" the routes associated with connecting cables.

⁵⁵ Bellcore, BOC Notes on the LEC Networks - 1994, p. 9-12.

As in HM 4.0, the Hatfield proponents have, in HM 5.0, replaced the coarse gauge, loaded loop technology used in HM 3.1 to provide service beyond 18,000 feet with copper-fed conventional T1 digital carrier and DLC in a misguided attempt to apparently meet the FCC requirement prohibiting the use of loading coils.⁵⁶

Conventional copper-based T1 digital carrier is a 1970s technology requiring specialized design and cable conditioning to function properly, especially when used on the small sized copper cables that are likely to be placed as "road cables" by the Hatfield Model. T-1 technology is definitely not forward-looking, and should not be used in a model purported to estimate forward-looking costs. Indeed the sponsor of AT&T's Non-Recurring Cost Model (NRCM) supported this position in a recent deposition when he agreed that it would not be forward-looking to utilize T-1 on copper in the loop under any circumstances in a DLC environment.⁵⁷

3. Digital Loop Carrier Investment

HM 5.0 assumes that the cost of a 672 line "high density GR-303" digital loop carrier ("NGDLC") system (without channel unit plug-ins) is \$66,000. Capital costs for rights-of-way, which can be substantial in suburban and metropolitan areas, have not been included beyond the \$3,000 allocated for site preparation and power. Site costs, including right-of-way, range from \$40,000 to \$60,000 in suburban areas and the costs of underground sites which are used by the ILECs in urban areas, but not modeled in HM 5.0, can range up to \$150,000.⁵⁸ Other costs, such as cabinet

⁵⁶ FCC further Notice of Proposed Rulemaking, Docket 96-45 and 97-160, July 18, 1997 at 86.

⁵⁷ Deposition of John Lynott In the State of California Before the Public Utilities Commission, Docket Nos. R.93-04-003 and I. 93-04-002, November 19, 1997, Page 437.

⁵⁸ Rebuttal testimony of C.R. Curbelo before the New York Public Utility Commission, Docket No. 95-C-0657, 94-C-0095, 91-C-1174, October 14, 1996.

costs, are significantly understated. In fact, HM 5.0 does not model the precast concrete huts ("PCHs") and controlled environment vaults ("CEVs") that are commonly used to house DLC remote terminals.

To estimate the cost of an additional 672 line system, when demand requires the installation of such a system, HM 5.0 adds only \$18,500 for each additional 672 channels of capacity instead of doubling the costs, as was included in earlier versions of the Hatfield Model. HM 5.0 is now modeling Next Generation Digital Loop Carrier ("NGDLC") from DSC Communication Corporation as its "High Density GR-303" solution. However, this equipment is currently only being tested by Bellcore and ILECs for full GR-303 connectivity with Lucent and Nortel switches. There are still many issues remaining to be resolved by the switch and NGDLC vendors before true GR-303 interoperability is commercially available. In addition, there is still no industry-wide consensus on the architecture that will be used to support the unbundling of subscriber lines that are provisioned on integrated DLC. All of the proposals to date require additional capabilities in either the switch, the DLC, or both. As those issues are resolved, hardware and software upgrades will undoubtedly be required in the switch and DLC equipment.

The predominate savings using GR-303 or TR-008, which are both integrated systems, is in the switch and not the DLC equipment. Actually, the integrated systems can be more expensive than TR-57 (universal) when unbundling loop elements to CLECs, especially when demand is low and /or lines from the same DLC are unbundled to multiple CLECs. Handing off loop elements from the switch interface ("hairpinning") uses up DS-1 ports in that switch interface, reducing its capacity and increasing costs. If "hairpinning" is used for unbundling, the additional switch costs associated with

unbundling loops provisioned on integrated DLC should be modeled. HM 5.0 neither recognizes the additional switch costs nor does it allocate additional switch costs to the loop.

Alternatively, handing off loop elements from the NGDLC multiplexer (virtual remote digital terminal) also uses up DS1 ports, thereby increasing the concentration ratio on the remaining DS1 ports and increasing costs. If the Virtual RDT approach is used for unbundling, the additional NGDLC costs associated with unbundling should be modeled. Here again, HM 5.0 fails to recognize these additional NGDLC costs.

4. IDLC Unbundling Assumptions Are Unrealistic

The provisioning methodology assumed in the HM for lines served via Integrated Digital Loop Carrier (IDLC) is highly questionable from both a technical and regulatory perspective. Loops provided on IDLC do not have Main Distributing Frame (MDF) appearances.⁵⁹ Consequently, some provision must be made for unbundling these loops at the DS0 level. The Hatfield Model makes no such provisions.

The Non-Recurring Cost Model (NRCM), sponsored by AT&T ,⁶⁰ assumes the same network architecture and engineering assumptions that are contained in the Hatfield Model.⁶¹ The NRCM assumes that unbundling will occur at the DS1 level using the time slot interchange (TSI) and multiple TR-303 Interface Group(IG) functionality of the Next Generation Digital Loop Carrier

⁵⁹Hatfield Model Description 5.0, page 12.

⁶⁰Joint Submittal of Cost Studies by AT&T of California, Inc. and MCI Telecommunications, in the State of California Before the Public Utilities Commission, Docket Nos. R. 93-04-003 and I. 93-04-002, September 15, 1997, Appendix G, The Non-Recurring Cost Model, Version 1.2.

⁶¹Deposition of John Lynott, in the State of California Before the Public Utilities Commission, Docket Nos. R. 93-04-003 and I.93-04-002, November 20, 1997, Volume IV, Pages 580-583.

(NGDLC) systems.⁶² In adopting this methodology, both the NRCM and HM assume that the CLEC will purchase "a channelized virtual DS1 feeder from the Remote Terminal to its collocation area."⁶³

The NRCM has gone so far as to categorize the "channelized virtual DS1" as Service Types 16 and 17 that can be ordered and installed via the service order process.⁶⁴ Likewise, there are separate Service Type designations for the distribution portion of the sub-loop. This does not comport with the First Report and Order where the FCC declined to identify the feeder, feeder/distribution interface (FDI), and distribution components of the loop as individual network elements.⁶⁵ Indeed, the FCC in that Order defined a loop as "a transmission facility between a distribution frame, or its equivalent, in an incumbent LEC central office, and the network interface device at the customer premise."⁶⁶

Furthermore, the multi-IG capability defined in TR-303 and assumed in the Hatfield Model and the NRCM provides Remote Terminal TSI access to any IG terminating on the Remote Terminal. This creates serious security issues that are preventing the technology from being uniformly accepted and implemented by the industry. More importantly, the actual provisioning of DS0 customer loops will require the ILECs to recombine network elements. The recent interpretation of the

⁶² Direct Testimony of John Lynott on Behalf of AT&T Communications of Pennsylvania, Inc. Before the Pennsylvania Public Utility Commission, Docket No. A-310125F0002 GTEN-II, November 13, 1997, p. 24, lines 2-8 and Exhibit JPL-2.

⁶³ Id.

⁶⁴ Joint Submittal of Cost Studies by AT&T of California, Inc. and MCI Telecommunications, in the State of California Before the Public Utilities Commission, Docket Nos. R. 93-04-003 and I. 93-04-002, September 15, 1997, Appendix G, The Non-Recurring Cost Model, Version 1.2.

⁶⁵ FCC First Report and Order, In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98, and In the Matter of Interconnection between Local Exchange Carriers and Commercial Mobile Radio Service Providers, CC Docket No. 95-185, released August 8, 1996, paragraph 391.

⁶⁶ Id., Paragraph 380.

Telecommunications Act of 1996 by the United States Court of Appeals for the Eighth Circuit does not require an ILEC to recombine network elements.⁶⁷ In other words, a CLEC cannot force the ILECs to recombine the sub-loop "virtual" feeder and associated sub-loop distribution plant to form a complete loop network element. Regulatory mandates aside, even if service were to be provided at this "sub-loop" level, a separate rate element and its associated cost must be developed. The Hatfield Model fails to develop either the rate element or its associated cost.

The Hatfield Model also assumes that all loops served by fiber are provided over IDLC. This means that loops are integrated with switches. It makes no sense, however, to use IDLC when providing UNEs since the provisioning of UNEs requires the *segregating* rather than the *integrating* of the loops and switches.

Loops provided over fiber require demultiplexing equipment to provide unbundled voice grade loops. Each voice grade loop requires a plug-in card, known as a channel unit. The channel unit must have options manually set on it, and must be placed in a channel slot of the demultiplexing equipment. Each channel slot associated with the demultiplexing equipment has a main distribution frame appearance which must be manually cross connected to the CLEC point of interconnection to allow the handoff of voice grade loops.

The FCC has concluded that the costs associated with work activities necessary to unbundle loops from IDLC should be recovered from requesting carriers.⁶⁸ But again, the Hatfield Model fails

⁶⁷Iowa Utilities Board versus Federal Communications Commission, et al., Before the US Court of Appeals, Eighth Circuit, Order of Petitions for Rehearing, October 14, 1997.

⁶⁸ FCC First Report and Order In the Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98, and In the Matter of Interconnection between Local Exchange Carriers and Commercial Mobile Radio Service Providers, CC Docket No. 95-185, released August 8, 1996, paragraph

to do this. IDLC is certainly not appropriate to use for a voice grade handoff of an unbundled loop. Yet the Hatfield Model, without even acknowledging the existence of the costs of unbundling voice grade services from IDLC systems, assumes that IDLC is used for all voice grade loops greater than nine kilofeet.

5. Drop Length Investment

HM 5.0's drop costs are based upon an aerial/buried mix by density zone, a material cost per foot, an average length of drop by density zone, and a labor cost per placement (not by foot) for aerial cable in each of the density zones. The drop cost assumptions understate material cost for both aerial and buried drop, the length of the drop, and burial and drop placement costs.

The Hatfield engineering team received five estimates concerning drop length in response to their surveys sent to various contractors. For rural areas, the lengths ranged from 94 to 375 feet. For suburban areas, length ranged from 75 to 100 feet. Although the shortest drop distance estimated in the industry survey was 75 feet, Hatfield assumes a drop distance of 50 feet in high-density zones. The Hatfield Inputs Portfolio, quoting from a Bellcore survey, indicates that, based on the most recent nationwide study of actual loop lengths, the average drop length is 73 feet.⁶⁹

When HM 5.0 is run for the companies included in the survey, it calculates an average drop length of 64 feet, understating the nationwide BOC drop wire investment by over \$750 million. The average drop length in the 1993 New Hampshire Incremental Cost Study, which the Hatfield modelers heavily rely upon for the Model's switch maintenance assumptions, was 125 feet.⁷⁰ When

384.

⁶⁹ Hatfield Inputs Portfolio, Section 2.2.1.

⁷⁰ 1993 New Hampshire Incremental Cost Study, p. 27, Attachment 4.